
The Relationship of Early Pain Scores and Posttraumatic Stress Disorder in Burned Soldiers

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Early acute pain after injury has been linked to long-term patient outcomes, including the development of posttraumatic stress disorder (PTSD). Several studies have identified a negative correlation between early anesthetic/analgesic usage and subsequent development of PTSD. This retrospective study examined the relationship between early acute pain and severity of PTSD symptoms in soldiers with burn injuries. Of the soldiers injured in Overseas Contingency Operations who had pain scores recorded at admission to the Emergency Department, 113 had burn injuries. Of those transferred to the military burn center, 47 were screened for PTSD using the PTSD checklist-military (PCL-M) survey at least 1 month after injury. Soldiers with mild, moderate, and severe pain scores had similar Injury Severity Scores and TBSA burned ($P = .339$ and $.570$, respectively). However, there were significant differences in PCL-M scores between the mild and severe pain groups ($P = .017$). The pain levels positively correlated with the PCL-M score ($\rho = 0.41$, $P = .004$) but not with injury severity markers (Injury Severity Score and TBSA). These data suggest that early acute pain may be related to increased PCL-M score and PTSD symptoms. The intensity of pain was not related to the injury severity, and these data also show no association between pain intensity and physiological measures, including blood pressure and heart rate. However, this is a small sample size, and many other factors likely influence PTSD development. Further study is necessary to explore the relationship between early acute pain and subsequent development of PTSD symptoms. (*J Burn Care Res* 2011;32:46–51)

Posttraumatic stress disorder (PTSD) is a psychological disorder characterized by recurrent flashbacks, nightmares, emotional disturbances, social withdrawal, and forgetfulness. It often arises after a traumatic experience in which the participant is threatened with harm or death. Predisposing factors for PTSD include experiencing a traumatic event, threat of injury or death, and threat to one's own physical integrity, such as untreated pain.^{1,2} In the civilian

population, the risk of PTSD increases if the participant is physically harmed. For example, this life-changing disorder has been reported to affect up to half of the burn patient population, with civilian burn centers reporting a range of 8 to 45%.^{3–6}

PTSD is also a relatively common condition for returning service members. Recent data suggest that close to 20% of service members who have been deployed suffer from PTSD.^{7–11} In contrast to the civilian population, injury alone does not seem to increase the risk of PTSD development in soldiers. PTSD rates among battle-injured soldiers returning from Overseas Contingency Operations are similar to those in noninjured soldiers.¹² However, increased levels of direct combat exposure combined with minor wounds or injuries correlate with higher rates of PTSD in soldiers.¹³ Other factors unique to the deployed soldier may also contribute to the development of PTSD symptoms. The stress of deployment and combat may lead to psychological maladjustment and the development of disorders, such as PTSD.

Early acute pain after injury has recently begun to be linked to long-term outcomes. Untreated pain is

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associated with PTSD,^{14–17} and burn patients who later developed PTSD received less morphine in the acute phase of injury.^{18,19} Unfortunately, untreated pain is often unavoidable for injured soldiers. Pain management strategies for combat casualties must balance requirements for emergent, life-saving care with the need to remove injured soldiers from harm's way. Complete elimination of acute pain may not be possible until evacuation to surgical Combat Support Hospitals or Forward Support Teams where experienced medical providers can perform general or regional anesthesia techniques. The effects of prolonged, uncontrolled pain and the development of PTSD symptoms in soldiers are unclear, but evidence has begun to emerge that suggests that early acute pain can affect PTSD development. Recently, Holbrook et al²⁰ reported that Marines who were subsequently diagnosed with PTSD received less morphine in the first 24 hours after injury than those Marines who did not develop PTSD. However, the relationship between early acute pain scores and the prevalence of PTSD symptoms in soldiers with burn injuries has not been examined.

This retrospective study investigates whether there is a relationship between early acute pain scores recorded in Emergency Departments (EDs) in theater, injury severity, and TBSA burned. This study also examines the association between early acute pain in EDs in theater and PTSD development in soldiers with burn injuries. The study additionally determines whether early acute pain levels are associated with later development of PTSD symptoms.

METHODS

After institutional review board approval, the Joint Theater Trauma Registry was queried to identify soldiers who had pain scores recorded in the ED in theater ($n = 2031$) and who had burn injuries ($n = 113$). Early acute pain scores were categorized as mild (0–3), moderate (4–6), and severe (7–10), based on comparison of a 0 to 10 scale with the verbal scale used by Zelman et al.²¹ Demographic data on soldiers with burn injuries including Injury Severity Score (ISS), TBSA burned, and other physiological parameters were also extracted. All soldiers admitted to the burn center are screened for PTSD using the PTSD checklist-military (PCL-M) version; however, only those soldiers who received the PCL-M screening at least 30 days after injury were included in our analyses ($n = 47$).

The PCL-M is a screening tool for PTSD that is authorized for use by the US military. It consists of 17 questions designed to capture 1 of 3 distinct clusters

of symptoms: reexperiencing, avoidance or numbing, or hyperarousal. Each question is rated on a scale of 1 to 5, resulting in a possible total score between 17 and 85. A score of 44 or higher yields a diagnostic efficiency of 0.900 for PTSD.¹³ For this study, a score of 44 or higher was considered a positive screen for PTSD. The complete diagnostic criteria for PTSD are described in the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (1994).¹⁴

Inclusion criteria for this study required the availability of a pain score recorded in the ED in the theater of operations, which is referred to herein as the early acute pain score. In addition, patients must have undergone screening for PTSD at least 1 month after injury using the PCL-M, and the most recent PCL-M score was used if there was more than one assessment after 30 days from the initial injury. After institutional review board approval, charts were reviewed to determine patient demographics, percent TBSA burned, ISS, Glasgow Coma Scale (GCS) score, and physiological parameters including heart rate and blood pressure (diastolic blood pressure and systolic blood pressure), hematocrit, and base deficit.

Statistical analysis included the Kruskal-Wallis test for nonparametric data sets and the Spearman correlation test to determine the relationship between pain levels and other factors. The null hypothesis was that pain levels were unrelated to the PCL-M score. The primary endpoint was the score on the validated PCL-M PTSD screening tool. Statistical significance was defined as $P < .05$.

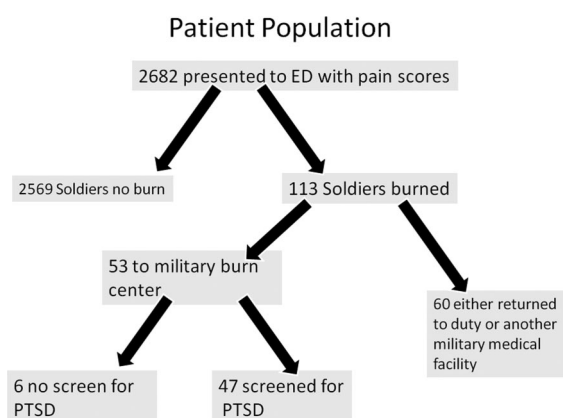


Figure 1. Schematic representation of patient population. The pain scores of 2682 soldiers were taken at admission to the Emergency Department (ED) in theater. Of those, 113 had burn injuries. Fifty-three soldiers were transferred to the military burn center. Forty-seven were screened for posttraumatic stress disorder (PTSD) more than 30 days after injury.

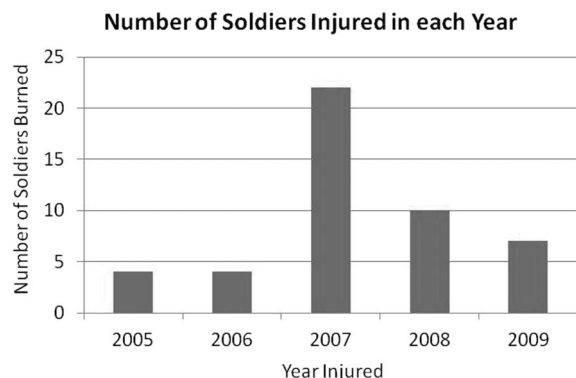


Figure 2. Date of soldier injury. The soldiers were grouped by year. Most soldiers with pain scores were injured in 2007.

RESULTS

Of the 2682 soldiers injured in Overseas Contingency Operations who had pain scores recorded at admission to the ED, 113 had burn injuries. Of the 113 who had burn injuries, 53 were transferred to the military burn center, and 47 were screened for PTSD more than 30 days after injury (Figure 1). The soldiers in this study were injured between 2005 and 2009, with most of the injuries occurring in 2007 (Figure 2). Because of the small number that successfully met inclusion criteria, soldiers were separated into mild, moderate, and severe pain groups on the basis of pain classifications.²¹ There were 11 who presented to the ED in theater with pain scores 0 to 3 on a scale of 0 to 10, which corresponds to a designation of mild pain. Thirteen presented with pain scores ranging from 4 to 6, indicating moderate pain. Twenty-three presented with pain scores of 7 or greater,

corresponding to severe pain. The demographics of all three groups of soldiers were similar. The soldiers were of the same age, and most were male. The soldiers in the different groups had similar lengths of stay and spent a similar number of days in the intensive care unit. They also underwent a similar number of surgeries overall and a comparable number of surgeries in the first 30 days after burn (Table 1). The groups received similar amounts of morphine equivalent units both during the total operative procedures and during each operative procedure (Table 1).

Pain is often believed to be based on severity of injury, but soldiers with mild, moderate, and severe pain scores had similar injury severity based on the ISS ($P = .339$, Table 2). The soldiers of each group also had similar total TBSA ($P = .570$, Table 3) and similar amounts of second- and third-degree burns. No differences in level of consciousness between the groups were evident based on the GCS score ($P = .519$, Table 2). The groups also had similar hematocrits and base deficits ($P = .356$ and $.704$, respectively) and had similar heart rates and blood pressure (Table 3).

Although there were no differences in the severity of the injuries sustained by soldiers experiencing mild, moderate, or severe pain, there were significant differences in PCL-M scores between the pain groups ($P = .017$; Table 4). The soldiers with higher pain scores had significantly higher PCL-M scores and more PTSD symptoms. The US Army Institute of Surgical Research uses the cutoff score of 44 to serve as a marker for PTSD development and further evaluation. However, there was no increase in PTSD incidence between the groups ($P = .552$; Table 4).

Table 1. Comparison of demographic characteristics between groups

	Mild Pain (n = 11)	Moderate Pain (n = 13)	Severe Pain (n = 23)	P
Age (yr)	25.9 ± 7.9	23.2 ± 3.1	26.9 ± 5.4	.120
Gender (%male)	100	100	95.6	.593
Length of stay	48.2 ± 111	13.8 ± 18	26.9 ± 61	.748
ICU (d)	16.5 ± 48	3.2 ± 10	14.3 ± 45	.608
MEU during stay	4770.1 ± 12504.4	1474.2 ± 2790.0	1784.4 ± 2654.2	.833
MEU per day	76.3 ± 41.5	89.0 ± 89.4	84.8 ± 60.0	.912
No. surgeries	3.5 ± 7.6	1.1 ± 1.6	2.2 ± 5.1	.892
MEU in OR	375.4 ± 948	45 ± 78.9	167.6 ± 528.8	.740
MEU per operative case	39.0 ± 46.0	16.6 ± 21.6	21.1 ± 33.3	.486
Surgeries in the first 30 d	0.36 ± 0.7	0.75 ± 1.1	0.87 ± 1.5	.660

Soldiers of each group had similar age, gender, length of stay, number of days in the ICU, and underwent a similar number of surgeries. The soldiers also received similar amounts of MEU during the operative procedures and during their stay.

ICU, intensive care unit; MEU, morphine equivalent units; OR, operating room.

Table 2. Comparison of injury severity between groups

	Mild Pain (n = 11)	Moderate Pain (n = 13)	Severe Pain (n = 23)	P
ISS	9.6 ± 10.9	6.8 ± 8.8	10.7 ± 10.2	.339
TBSA	15.2 ± 18.5	12.7 ± 14.3	17.6 ± 20.3	.570
Second-degree TBSA	5.4 ± 4.6	4.6 ± 3.8	8.2 ± 4.8	.093
Third-degree TBSA	11.2 ± 18.7	10.5 ± 17.7	10.6 ± 17.7	.926
GCS total	13.7 ± 4.0	15 ± 0.0	14.9 ± 0.3	.519
HCT	48.3 ± 6.3	45.1 ± 5.4	44.0 ± 10.5	.356
Base deficit	-3.0 ± 5.5	-1.9 ± 3.7	-2.8 ± 3.5	.704

The soldiers had similar ISS, TBSA, and GCS.

ISS, Injury Severity Score; GCS, Glasgow Coma Scale; HCT, hematocrit.

Spearman's test was used to determine whether there was a correlation between pain levels and physiological parameters or PCL-M scores. The pain levels positively correlated with the PCL-M score ($\rho = 0.41$, $P = .004$, Table 5). There was no significant correlation between the early acute pain intensity and ISS, TBSA, or heart rate (Table 5).

LIMITATIONS

This is a retrospective study with all the inherent limitations. There was sample bias in this study because soldiers had to be alert enough to report a pain score on admission to the ED. The use of the PCL-M as the primary tool for diagnosis of PTSD also introduces limitations into the study. Screening using the PCL-M requires at least 30 days between the date of injury and patient survey. The patient had to be willing to complete a PCL-M 30 or more days after injury. The PCL-M screen also assumes that the soldier is available for assessment at US Army Institute of Surgical Research more than 30 days after injury. Individual patients were not matched for TBSA and ISS because of the small sample size. In addition, this study makes the assumption that PTSD symptoms arose from the traumatic event that resulted in the burn injuries of patients. However, it is possible that PTSD symptoms could have developed as a result of other traumatic or stressful events. Finally, this study

did not address other treatment issues, such as how pain during treatment influences the development of PTSD.

DISCUSSION

There are no reliable mechanisms to predict PTSD development. The severity of physical injury (burn size) was originally believed to be a potential indicator of PTSD development; however, several studies have shown that PTSD does not correlate with burn size in burn patient populations.^{4,22} Recent studies have provided evidence for a link between pain and the development of PTSD symptoms.^{14,15,19,20} Although this study did not find a statistically significant difference between early acute pain score groups in the percentage of patients who developed PTSD, we did find a positive correlation between the score on the PCL-M, which indicates the presence of PTSD symptoms, and early acute pain scores.

In evaluating these data, it is important to note that the extent to which a patient is experiencing PTSD symptoms is positively correlated to the patients' score on the PCL-M. For example, while a patient who scores a 40 on the PCL-M does not meet the stringent diagnostic criteria for PTSD, the patient is still experiencing symptoms of PTSD, some of which may be severe or interfere with normal function. Therefore, our study suggests that those patients who

Table 3. Comparison of physiological response between groups

	Mild Pain (n = 11)	Moderate Pain (n = 13)	Severe Pain (n = 23)	P
SBP	131.4 ± 21.7	136 ± 22.5	144.3 ± 19.6	.270
DBP	72.2 ± 16.1	67.1 ± 16.1	109.0 ± 145.6	.163
Heart rate	96.1 ± 34.5	87.8 ± 26.3	94.7 ± 14.4	.859

The soldiers had similar SBP, DBP, and heart rates.

SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 4. PCL-M score in the groups with differing pain intensities

	Mild Pain (n = 11)	Moderate Pain (n = 13)	Severe Pain (n = 23)	P
PCL-M score	25 ± 13.5	30.8 ± 12.9	35.4 ± 14.8	.017*
PTSD incidence	2/11 (18.2%)	3/13 (23.1%)	8/23 (34.8%)	.552

The PCL-M score was significantly different in the groups with differing pain intensities. The soldiers with the highest acute pain score had significantly higher PCL-M scores indicating more PTSD symptoms. However, there was not a statistical difference in the prevalence of PTSD.

PCL-M, posttraumatic stress disorder checklist-military; PTSD, posttraumatic stress disorder; *, statistically significant.

experience the most severe acute pain may be at risk for increased PTSD symptoms later on. More data and larger sample sizes are needed to evaluate the validity of this idea. PTSD is a complex illness whose biological and psychological basis can be difficult to ascertain. In this patient population, the stressor that initiated PTSD development was not definitively determined. The soldiers were exposed to multiple stressful situations, including deployment, combat and the potential for combat, and injury. Evidence suggests that noninjured soldiers have a similar rate of PTSD to injured soldiers,^{23,24} but this study makes the assumption that PTSD symptoms arose from the traumatic event that led to the burn injury or the polytrauma injury. However, this may not be the case. Burns frequently require numerous painful and repetitive painful procedures, including dressing changes, wound debridement, and surgical interventions. The exposure of these burn patients to repeated painful treatments may also contribute to PTSD development.

This study lacks a control group with similar levels of PTSD and must rely on historical controls of the prevalence of PTSD in uninjured soldiers and soldiers who were not severely injured.^{7-11,12} The overall prevalence of PTSD in this study regardless of injury severity, pain score, or burn size is 27.7% (13/47). This is similar to findings from other groups with burned civilians having an incidence of PTSD be-

tween 8 and 45%. The authors make the assumption that the PTSD is a result of the traumatic event in which the soldier was injured. This may not be the case. The soldiers have been exposed to stressors that may have triggered PTSD before the injury, and the pain may be a symptom of the PTSD. Perceived pain is a consequence of baseline coping mechanisms. However, in this study, there is no way to distinguish which of these scenarios is correct.

The patients in this study were injured between 2005 and 2009. During this time, continual improvements were being made to treat the soldiers. However, because of the small sample size, we were not able to determine their effect on PTSD development. Changes to treatment include the burn resuscitation algorithm, new skin substitutes, and new medications. In the literature, many have observed changes in physiological parameters after painful stimuli (reviewed in Refs. 25 and 26). In this study, differences in pain intensity were not correlated with changes in physiological parameters. This could be due to a multitude of factors; for instance, these soldiers were injured in theater, which is an environment that is inherently stressful and exposes the soldiers to tense situations and high levels of danger. Increased stress levels induce autonomic nervous system activation, which mimics the pain response. This response could potentially explain the failure to detect physiological differences between the different groups, because even in the absence of pain, the autonomic nervous system is activated.

Although a large percentage of soldiers presented with high pain scores in the ED, there are some extenuating circumstances. The treatment of pain in austere settings balances the need for life-saving interventions, patient monitoring, and pain control. These factors are compounded by the fact that a medic has to carry the equipment, drugs, and normal battle gear. The medic is often faced with the choice of saving someone's life and treating pain. The most common pain control method in the hands of the medic is the morphine autoinjector. However, morphine, like many opioids, causes respiratory depres-

Table 5. The correlation of PCL-M score, ISS, TBSA, and heart rate with pain intensity

	Correlation (r) with pain intensity (P value)
PCL-M score	.41 (.004)*
ISS	.177 (.235)
TBSA	.132 (.375)
Heart rate	.022 (.885)

Acute pain intensity correlates with increased PTSD symptomology as recorded on the PCL-M.

PCL-M, posttraumatic stress disorder checklist-military; ISS, Injury Severity Score; *, statistically significant.

sion and decreased heart rate. Lacking sophisticated monitoring equipment, the increased risk to the soldier may be deemed too great.

CONCLUSIONS

These data suggest that increased early acute pain scores/intensities may be related to subsequent development of increased PTSD symptoms. The intensity of pain was not related to the injury severity (ISS or TBSA) or other examined physiological properties. However, this is a small sample size, and multiple factors play important roles in PTSD development. Further studies will be aimed at understanding the effects of pain and pain treatments on the development of PTSD.

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